The Relationship between Vasectomy and Angiographically Determined Atherosclerosis in Men

By: Alfred A. Rimm, Raymond G. Hoffmann, Alfred J. Anderson, Harvey W. Gruchow, and Joseph J. Barboriak

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Abstract:

Long-term prospective studies in monkeys have shown that vasectomy is associated with an increase in atherosclerotic disease. The purpose of the present investigation is to evaluate whether vasectomy in men is associated with atherosclerotic disease in the coronary arteries. In this study information was obtained on the vasectomy status in a series of 7,420 men who had previously been referred for coronary angiography because of cardiovascular symptomatology and have been followed for as long as 9 years to evaluate coronary artery bypass surgery and the natural history of the disease. It was found that 5.0% had a vasectomy prior to angiography. Two different data analysis procedures were used to determine whether the vasectomized men had a greater degree of angiographically determined coronary occlusive disease than the nonvasectomized men. Subgroups with minimal and extensive coronary artery disease were also analyzed. Results of all analyses show that the vasectomized men did not have more coronary occlusive disease. Possible patient selection biases in this study are discussed.

Article:

INTRODUCTION

Vasectomy has become a widespread means of contraception in the United States and other countries. By 1976 it was estimated that more than 10% of U.S, men who were married to women of childbearing age had undergone a vasectomy (18). It is now estimated that more than 10 million men in the United States have had this procedure. Whereas the rare short-term side effects of vasectomy, such as wound infection, epididymitis and hematomas (5), and sexual difficulty (7), have been reported, the long-term sequelae, if any, have not been identified (16, 17). A long-term study in vasectomized rhesus monkeys has suggested that the immunological response to sperm antigens may be associated with an accelerated development of atherosclerotic plaque (9). Antibody production to sperm in men may first appear between 6 weeks and 6 months following vasectomy. The antibody titers increase for varying periods of time and may persist for many years (4). The variability among men of the autoimmune response to the sperm antigens may be related to an immune response gene. This was hypothesized by Law *et al. (11)* who found that the HLA antigen, A28, was associated with production of head agglutinating antibody. If genes do control the immune response to sperm antigens, the levels of antibody and their possible adverse effects should differ considerably among vasectomized men.

In this investigation of white men who had had a coronary angiogram, we studied whether the degree of occlusion of the coronary arteries was different between the vasectomized and nonvasectomized men. Our results provide no evidence for any association between atherosclerosis and vasectomy in men.

METHODS

The Milwaukee Cardiovascular Data Registry is an ongoing computerized system for storing comprehensive clinical data for patients referred to selected Milwaukee hospitals since 1972 (St. Luke's Hospital and Veterans Administration (VA) Medical Center) for diagnostic coronary angiography. The patients in the Registry are contacted each year. When the patients were contacted in 1980 they were asked whether they had ever had a vasectomy and, if so, the date it was performed.

The four major indications for which patients are referred for coronary angiography include: (a) unstable angina pectoris, (b) moderate to severe stable angina, (e) previous myocardial infarction, and (d) recurrent chest pain of unknown origin. Slightly less than half of the patients who had angiography had undergone coronary artery bypass surgery (CABS). A subgroup of patients with CABS and a subgroup of patients who did not have the operation have been studied extensively for changes in cardiovascular risk factors at a yearly interval following the angiography. Data on cardiovascular risk factors are available for analyses on these smaller numbers of patients.

A vasectomy questionnaire, which was attached to the yearly follow-up form in 1980, contained questions about five different operations, with "vasectomy" midway in the list. Patients who did not return the questionnaire were contacted by telephone. There were no significant differences between the mail and telephone respondents with regard to any of the factors studied.

To assess the degree of atherosclerotic disease in the coronary arteries, each coronary angiographic record was evaluated independently by a radiologist and a cardiologist shortly after the angiographic procedure, and the results were recorded according to a uniform protocol. The extent of the coronary artery occlusion was scored according to a system suggested by Rowe *et al.* (13) with the exception that the scale was inverted such that a score of 0 reflects no measureable occlusive disease and a maximum score of 300 indicates occlusion of all main coronary branches. Information on drinking, smoking, age, history of hypertension , and other pertinent data were obtained at the time of the coronary angiography from medical histories, special questionnaires, and by direct questioning of the patients.

Alcohol consumption was calculated on the basis of the alcohol content of the beverages and expressed in ounces of absolute alcohol per week. Smoking habit was graded on a five-point scale: 1 = not currently smoking and no history of smoking, 2 = less than one-half pack per day for less than 20 years, or cigars only, $^{(-4}$' Pipe only, 3 = one pack per day for less than 20 years or one-half pack per day for more than 20 years, 4 = one and one-half packs per day for less than 20 years, or one pack per day for more than 20 years, 5 = two packs or more per day for 20 years or one and one-half packs or more per day for 30 years (3).

Education level was measured on an eight-point scale based on highest level completed: 1 = 1-8 grades, 2 = 9-10 grades, 3 = 11-12 grades—no diploma, 4 12 grades—diploma, 5 = less than 1 year of college, 6 = 1-3 years of college or business school, 7 = college graduate, and 8 = graduate school (12).

Two different statistical procedures were used to compare the vasectomized and nonvasectomized men with respect to the degree of coronary occlusion: (a) overall comparisons of pooled data were made using the *t* test with adjustment for multiple contrasts, and (b) multiple regression analysis which included risk factors thought to be associated with the degree of coronary occlusion (in this analysis vasectomy status was given a 0 or 1 designation) (14). The analyses were performed either on the entire group of subjects or on subgroups of subjects with extensive and minimal coronary artery occlusion. In addition, analyses were performed on a group which was selected by matching each vasectomized man according to age, with four nonvasectomized men.

RESULTS

Table 1 shows the number of vasectomized and nonvasectomized men grouped according to degree of occlusion and time interval from vasectomy to coronary angiography. Those men who had had a vasectomy following the coronary angiography were included in the no vasectomy group.

Of the 7,420 men studied in Table 1,370 (5.0%) reported having had a vasectomy performed before the angiographic procedure. There were 79 men who had undergone a vasectomy at least 10 years prior to coronary angiography. There was no indication that there was a greater proportion of long-term (≥l0 years) vasectomized men among those with high occlusion scores compared to those with low occlusion scores. Only 1.0% of the long-term men with high occlusion scores (≥150) had undergone a vasectomy, where 1.3% of the long-term men with low occlusion scores (<50) had undergone a vasectomy. As expected, the youngest men had a higher

prevalence (8.8%) of vasectomies than the oldest men (2.5%). The overall results show that 7.1% of the men with low occlusion scores had undergone a vasectomy and only 3.9% of the men with high occlusion score" had had a vasectomy.

TABLE 1

DISTRIBUTION OF PATIENTS ACCORDING TO AGE, VASECTOMY STATUS,[a] INTERVAL FROM VASECTOMY TO SUBSEQUENT ANGIOGRAPHY, AND OCCLUSION SCORE

Age	Vasectomy status	Interval[b] (years)	<50		50–149		≥150		Total	
			N[c]	%	N	%	N	%	N	%
<50	No		404	88.4	606	92.0	937	92.0	1947	92.1
	Yes	<5	31	6.8	24	3.6	35	3.4	90	4.2
	Yes	5–9	17	3.7	25	3.8	34	3.3	76	3.6
	Yes	10–14	5	1.1	4	0.6	12	1.2	21	1.0
	Total vasectomies		53	11.6	53	8.0	81	8.0	187	8.8
	Total patients		457		659		1018		2134	
50–59	No		644	93.9	816	96.3	1726	96.6	3186	96.0
	Yes	<5	15	2.2	17	2.0	21	1.2	53	1.6
	Yes	5–9	15	2.2	5	0.6	19	1.0	39	1.2
	Yes	10–14	12	1.7	9	1.1	21	1.2	42	1.3
	Total vasectomies		42	6.1	31	3.7	61	3.4	134	4.1
	Total patients		686		847		1787		3320	
≥60	No		404	96.2	498	95.4	1015	99.1	1917	97.5
	Yes	<5	8	1.9	4	0.8	3	0.3	15	0.8
	Yes	5–9	4	0.9	12	2.3	2	0.2	18	0.9
	Yes	10–14	4	1.0	8	1.5	4	0.4	16	0.8
	Total vasectomies		16	3.8	24	4.6	9	0.9	49	2.5
	Total patients		420		522		1024		1966	
All	No		1452	92.9	1920	94.7	3678	96.1	7050	95.0
	Yes	<5	54	3.5	45	2.2	59	1.5	158	2.1
	Yes	5–9	36	2.3	42	2.1	55	1.4	133	1.8
	Yes	10–14	21	1.3	21	1.0	37	1.0	79	1.1
	Total vasectomies		111	7.1	108	5.3	151	3.9	370	5.0
	Total patients		1563		2028		3829		7420	

[a] Patients reporting vasectomy performed after angiography are included in the no-vasectomy category.
[b] Interval from vasectomy to angiography.
[c] Number of patients.

Table 2 shows the results of the comparisons between vasectomy and non-vasectomy groups. The Dunnett's *t* test was used to compare each vasectomy group with the nonvasectomy group. Since this is a more conservative approach than an unadjusted *t* test, borderline significance levels ($0.05 < P < 0.10$) are given to indicate possible trends. The results in Table 2 show that the patients who had coronary angiography less than 10 years after the vasectomy are younger than the nonvasectomized patients. As expected, the education level of the vasectomized men was significantly higher than that of the nonvasectomized men. Both the long-term and short-term vasectomy groups were more obese than the no- vasectomy group. It is noteworthy that the mean occlusion score (114) for the short-term vasectomy group was significantly lower than the mean for the group of men who did not have vasectomy.

Among the men with long-term (≥10 years) vasectomy, 46.4% reported a history of hypertension; this rate was *not* statistically significantly higher ($0.1 > P > {}^{0}.05$) than the 32.8% rate among the men who did not have a vasectomy. However, this difference in rates may suggest a trend as noted by Alexander *et al.* (2). The interpretation of this possible trend is difficult because the date that hypertension was first diagnosed was not uniformly recorded by the referring physician. Thus some of the vasectomized patients may have had their initial diagnosis of hypertension prior to vasectomy. These random-error type problems would tend to reduce or obscure the association between hypertension and vasectomy, not cause the difference noted in Table 2. Though blood pressure measurements were available at the time of coronary angiography, they were not representative because many hypertensive patients were under treatment for their disease.

TABLE 2
OVERALL COMPARISON BETWEEN VASECTOMY AND NONVASECTOMY GROUPS FOR FACTORS STUDIED

Factor	No vasectomy (7,050[b]; 4,545[c])	Vasectomy <10[a] (291; 188)	Vasectomy ≥10[a] (79; 56)
Coronary occlusion score	140 (86)[d]	114 (87)**	121 (79)
Age	54.1 (8.1)	49.1 (7.9)**	53.5 (6.5)
Weight/height²	3.75 (0.48)	3.83 (0.47)*	3.97 (0.55)**
% Hypertension	32.8	34.0	46.4***
Triglyceride (mg/dl)	194 (108)	197 (110)	190 (116)
Cholesterol (mg/dl)	245 (52)	248 (55)	245 (52)
% Diabetes	9.3	9.0	14.3
% Anginal pain	63.3	60.6	61.8
% Chest pain	74.7	77.1	74.5
% Myocardial infarction	53.1	50.5	55.4
Smoking	3.42 (1.34)	3.49 (1.22)	3.44 (1.41)
Alcohol (oz/week)	5.67 (7.80)	6.77 (9.55)	5.90 (5.88)
Education	4.23 (2.11)	4.71 (1.96)**	4.96 (2.04)*
% CABS[e]	57.3	44.7**	49.4

[a] Interval from vasectomy to angiography in years.
[b] Number of patients with complete data recorded for occlusion, age, and number of bypasses.
[c] Number of patients with data recorded for all variables; this may vary slightly for individual risk factors.
[d] Standard deviations in parentheses.
[e] Coronary artery bypass surgery.
* $P < 0.05$ compared with the no-vasectomy group.
** $P < 0.01$ compared with the no-vasectomy group.
*** $P < 0.10$ compared with the no-vasectomy group.

To explore further the differences between the vasectomy and nonvasectomy, groups after adjusting for age, each vasectomized patient was matched by age (± 1year) with four nonvasectomized men. Table 3 shows that these results do not differ substantially from those of the unmatched analysis. In this analysis, the differences between long-term vasectomized men and those with no vasectomy with regard to a history of hypertension were similar to the results in Table 2. It is unclear why the percentage of men who had had CABS is higher in the nonvasectomy matched control groups. One explanation may be that since there is less atherosclerotic disease in the vasectomized men, as judged by occlusion score',, as a group they would have less need for CABS.

TABLE 3
RESULTS OF THE AGE-MATCHED[a] GROUP OF VASECTOMIZED AND NONVASECTOMIZED PATIENTS

Factor	Vasectomy <10[b] (291[c]; 188[d])	Matched control (1,164; 752)	Vasectomy ≥10[b] (79; 56)	Matched control (316; 224)
Coronary occlusion score	114**	140	121**	150
Weight/height²	3.83	3.78	3.94***	3.82
% Hypertension	34.0	28.2	46.4***	31.6
Triglycerides (mg/dl)	203	206	190	208
Cholesterol (mg/dl)	248	248	245	246
% Diabetic	9.0	7.5	14.3	9.9
% Anginal pain	60.6	59.5	61.8	60.9
% Chest pain	77.1	71.8	74.6	75.0
% Myocardial infarction	50.5	55.3	55.4	58.0
Smoking	3.49	3.44	3.44	3.40
Alcohol (oz/week)	6.77	5.87	5.90	4.85
Education	4.40**	3.86	4.33	3.78
% CABS[e]	44.1	58.8	48.1*	61.4

[a] Four nonvasectomized "control" men were matched with each vasectomized man according to age (±1 year).
[b] Interval in years from vasectomy to angiography.
[c] Number of patients with complete data recorded for occlusion, age, and number of bypasses.
[d] Number of patients with data recorded for all other variables, this may vary slightly for individual risk factors.
[e] Coronary artery bypass surgery.
* $P < 0.05$ compared with the no-vasectomy-matched control group.
** $P < 0.01$ compared with the no-vasectomy-matched control group.
*** $P < 0.10$ compared with the no-vasectomy-matched control group.

Multivariate Analyses

The multiple regression procedure was used to determine whether vasectomy was associated with the degree of coronary occlusion after adjustment for other risk factors. The patients used were those selected by matching as shown in Table 3: each vasectomized patient was matched according to his age with four nonvasectomized patients. Table 4 shows those factors that were associated with the Coronary occlusion score. Among the long-term vasectomized men and their age-matched controls, only age was found to be associated with the occlusion score. This explained only 4.1% of the total variation in occlusion score. Among the short-term vasectomized men and their age-matched controls, age, smoking, and triglyceride level were positively associated with the occlusion score, and alcohol consumption was negatively associated with the score. There was no relationship between vasectomy and occlusion score for either group of men.

TABLE 4
RESULTS OF MULTIPLE REGRESSION ANALYSIS SHOWING FACTORS ASSOCIATED WITH THE CORONARY OCCLUSION SCORE

	Interval from vasectomy to angiography					
	<10 years (n = 109)[a]			≥10 years (n = 32)[a]		
	P	B[b]	SE[c]	P	B[b]	SE[c]
Age[d]	*	1.14	0.51	*	2.38	1.17
Alcohol[d]	**	−1.93	0.65	NS[e]	—	—
Cholesterol	***	0.14	0.08	NS	—	—
Diabetes	NS	—	—	NS	—	—
Education	NS	—	—	NS	—	—
Weight/height^2	NS	—	—	NS	—	—
Smoking[d]	*	6.42	3.2	NS	—	—
Triglyceride[d]	*	0.06	0.03	NS	—	—
Hypertension	NS	—	—	NS	—	—
Vasectomy	NS	—	—	NS	—	—
R^2	0.071			0.041		

[a] Number of vasectomized men in the analysis. Nonvasectomized men = 4N.
[b] Regression coefficient.
[c] Standard error for coefficient.
[d] Increased age, smoking, and triglycerides associated with increased occlusion score. Increased alcohol consumption associated with lower occlusion score.
[e] NS, Not statistically significant, p > 0.10.
* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.10$.

TABLE 5
RESULTS OF THE COMPARISON BETWEEN VASECTOMIZED AND NONVASECTOMIZED PATIENTS WHO HAD UNDERGONE CABS[a]

Factor	No vasectomy (4,041[c]; 2,937[d])	Vasectomy <10[b] (207; 107)	Vasectomy ≥10[b] (83; 47)
Coronary occlusion score	183 (65)[e]	178 (62)	182 (49)
Age (years)	53.8 (7.7)	47.4 (6.6)**	53.3 (6.5)
Weight/height^2	3.75 (0.46)	3.79 (0.49)	3.81 (0.37)
% Hypertension	31.5	38.3	46.8*
Triglyceride (mg/dl)	205 (108)	204 (116)	222 (129)
Cholesterol (mg/dl)	254 (52)	254 (56)	258 (48)
% Diabetes	10.2	10.3	17.0
% Anginal pain	69.7	75.7	66.0
% Chest pain	78.2	86.9*	76.6
% Myocardial infarction	55.5	57.9	68.1***
Smoking	3.41 (1.34)	3.46 (1.30)	3.28 (1.44)
Alcohol (oz/week)	5.38 (8.06)	6.74 (10.91)	5.77 (6.21)
Education	4.23 (2.09)	4.66 (1.68)	4.52 (2.09)
Number of arteries bypassed	3.10 (1.23)	3.37 (1.29)**	3.26 (1.22)

[a] Coronary artery bypass surgery.
[b] Interval from vasectomy to angiography in years.
[c] Number of patients with data recorded for occlusion, age and number of bypasses.
[d] Number of patients with data recorded for all other variables; this may vary slightly for individual risk factors.
[e] Standard deviation.
* $P < 0.05$ compared with the no-vasectomy group.
** $P < 0.01$ compared with the no-vasectomy group.
*** $P < 0.10$ compared with the no-vasectomy group.

Subgroup Analyses

The men with the most severe disease were those who had undergone CABS. These patients were studied as shown in Table 5. Again there was no indication that the vasectomized men had higher occlusion scores than the nonvasectomized men. Table 6 shows the comparison between vasectomized and age-matched non-vasectomized men who had undergone CABS. Though there appeared to be no relationship between vasectomy and degree of coronary occlusion, the percentages of patients with hypertension in the long- and short-term vasectomy groups were higher than those for the matched controls.

TABLE 6

RESULTS OF THE AGE-MATCHED[a] ANALYSIS OF VASECTOMIZED AND NONVASECTOMIZED PATIENTS WHO HAD CABS[b]

	Vasectomy <10[c] (207[d]; 110[e])	Matched control (828; 440)	Vasectomy ≥10[c] (83; 47)	Matched control (332; 188)
Coronary occlusion score	178	176	182	184
Weight/height²	3.79	3.76	3.81	3.81
% Hypertension	38.3*	27.6	46.8***	32.5
Triglycerides (mg/dl)	204	228	222	210
Cholesterol (mg/dl)	254	261	258	250
% Diabetic	10.3	10.2	17.0*	7.7
% Anginal pain	75.7***	67.7	66.0	60.7
% Chest pain	86.9*	78.0	76.6	73.0
% Myocardial infarction	57.9	58.0	68.1***	54.5
Smoking	3.46	3.51	3.28	3.42
Alcohol (oz/week)	6.74	5.28	5.77	5.14
Education	3.72	3.61	3.39	3.76
Number of arteries bypassed	3.37**	2.98	3.26	3.04

[a] Four nonvasectomized men were matched with each vasectomized man according to age (±1 year).
[b] Coronary artery bypass surgery.
[c] Interval in years from vasectomy to angiography.
[d] Number of patients with data recorded for occlusion, age, and number of bypasses.
[e] Number of patients with data recorded for all other variables; this may vary slightly for individual risk factors.
* $P < 0.05$ compared with the no-vasectomy group.
** $P < 0.01$ compared with the no-vasectomy group.
*** $P < 0.10$ compared with the no-vasectomy group.

TABLE 7

RESULTS OF THE AGE-MATCHED[a] ANALYSIS OF VASECTOMIZED AND NONVASECTOMIZED PATIENTS WITH OCCLUSION SCORES LESS THAN 150 AND WHO DID NOT HAVE CABS[b]

	Vasectomy <10[c] (141[d]; 84[e])	Matched control (564; 336)	Vasectomy ≥10[c] (34; 18)	Matched control (136; 72)
Coronary occlusion score	46.0***	54.8	46.9	51.5
Weight/height²	3.86***	3.77	4.04*	3.76
% Hypertension	31.0	27.6	38.9	35.6
Triglycerides (mg/dl)	195	177	156	180
Cholesterol (mg/dl)	233	232	223	230
% Diabetic	8.3	6.0	5.6	6.9
% Anginal pain	47.6	47.9	52.9	49.3
% Chest pain	69.1	67.5	64.7	67.1
% Myocardial infarction	41.7	42.8	33.3	37.0
Smoking	3.33	3.41	3.17	3.17
Alcohol (oz/week)	7.65***	5.84	5.97	5.54
Education	4.89	4.39	5.44**	4.00

[a] Four nonvasectomized men were matched with each vasectomized man according to age (±1 year).
[b] Coronary artery bypass surgery.
[c] Interval in years from vasectomy to angiography.
[d] Number of patients with data recorded for occlusion, age, and number of CABS.
[e] Number of patients with data recorded for all other variables; this may vary slightly for individual risk factors.
* $P < 0.05$ compared with the no-vasectomy group.
** $P < 0.01$ compared with the no-vasectomy group.
*** $P < 0.10$ compared with the no-vasectomy group.

In an effort to identify a group of men who most closely approach the general population in this age range, the patients who had not undergone CABS and had occlusion scores <150 were studied. These patients were recommended for coronary angiography because of symptomatology stemming from apparent ischemia, yet their degree of coronary occlusive disease was relatively small so that surgical intervention was not indicated. Table 7 shows the analysis of these men where each vasectomized man was age-matched with four nonvasectomized men. Again, there was no indication of more extensive occlusive disease in the vasectomized men.

TABLE 8

RESULTS OF MULTIPLE REGRESSION ANALYSIS SHOWING FACTORS ASSOCIATED WITH THE CORONARY OCCLUSION SCORE FOR THE CABS[a] PATIENTS AND THOSE WITH LOW OCCLUSION SCORES

	No CABS and occlusion score less than 150		CABS Patients	
	<10 years (n = 486)[b]	≥10 years (n = 12)[b]	<10 years (n = 54)[b]	≥10 years (n = 19)[b]
Age	NS[c]	NS	**	***
Alcohol	NS	NS	NS	NS
Cholesterol	NS	NS	NS	NS
Diabetes	NS	NS	NS	NS
Education	NS	NS	NS	NS
Weight/height²	NS	NS	NS	NS
Smoking	**	NS	NS	NS
Triglycerides	**	NS	NS	NS
Hypertension	NS	NS	NS	***
Vasectomy	***[d]	NS	NS	NS
R^2	0.083	–	0.027	0.051

[a] Coronary artery bypass surgery.
[b] Number with vasectomy. The patients without vasectomy in this analysis were matched for age with the vasectomized patients in a ratio of 4 to 1. Therefore the number of nonvasectomized men in each analysis is 4n.
[c] NS, not statistically significant, $P > 0.10$.
[d] Vasectomy associated with lower occlusion score.
* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.10$.

Table 8 shows the results of the multivariate analysis of the subgroup of patients with severe occlusive disease (Table 6) and those with minimal occlusive disease (Table 7). These results show that vasectomy was not associated with degree of occlusion of the coronary arteries.

The multiple logistic procedure (15) was used to study the relationship between vasectomy and history of hypertension. When all the risk factors, as shown in Table 8, were included, no statistically significant relationship was found between vasectomy and hypertension. The probability level for this relationship was $P < 0.1$.

DISCUSSION

This study of men who had symptoms of heart disease which warranted diagnostic coronary angiography clearly does not represent a random sample of men in the population. This fact, however, does not preclude the evaluation of the relationship between vasectomy and degree of coronary occlusion. Though these men had more occlusive disease than the general population, one might expect that if vasectomy accelerated the development of coronary occlusive disease then men with a vasectomy would have more disease than the nonvasectomized men. However, it may be argued that the men without a vasectomy were "selected" into the study because of their severe occlusive disease, and this would result in high occlusion scores among the nonvasectomized men, also. This in turn would obscure a difference between the vasectomized and nonvasectomized groups, under the assumption that vasectomy did play a role in the development of atherosclerosis Assuming that vasectomy accelerates the development of atherosclerosis, One would expect the vasectomized patients in this study to be younger; and in fact they are (Table 2). However, this may be due to the fact that the popularity of vasectomy is a relatively recent development, and only younger men with fertile

wives had the procedure performed. We would not expect many of the older men he study to have had a vasectomy earlier in life because it was not a widely used method of contraception during the years during which their wives were fertile.

To take into account the differences in age between the two groups of men, the vasectomized men were matched for age with the nonvasectomized men. If vasectomy accelerates the development of coronary occlusive disease, we would theoretically expect each vasectomized man to have a more advanced stage of occlusive disease than their age-matched nonvasectomized counterparts. The results show, however, that the vasectomized men do not have a higher degree of coronary occlusion than their age-matched controls. The only trend noted was, in fact, in the opposite direction. The vasectomized men had a significantly lower degree of coronary occlusion (Table 3) than their age-matched controls.

The results reported here are not in agreement with the findings of Clarkson, Alexander, and Anderson (1, 9). They observed increased atherosclerosis in vasectomized monkeys fed a lab chow devoid of cholesterol and low in fat. The speculated that "the immunologic response to vasectomy resulted in injury to the vascular endothelium and thereby resulted in a more rapid progression of disease." The vasectomized monkeys had more atherosclerotic disease in the thoracic, abdominal, and iliac arteries and in the right carotid bifurcation. In their studies the coronary arteries were not examined.

In the present study of men there appeared to be a weak association between vasectomy and a history of hypertension when univariate analytic techniques were used. When multivariate techniques were employed there was no indication that vasectomy was associated with a reported history of hypertension. There is no definitive evidence in this study that hypertension is associated with vasectomy. A recent study (2) of 946 men suggests that there may be an association between the long-term sequelae of vasectomy and systolic blood pressure. In any event, the present study and the above study do not have a sufficient number of long-term vasectomized men to make any definitive statements about the association between vasectomy and hypertension.

A highly speculative mechanism which may explain the possible association between vasectomy and hypertension involves autoimmunity and its effect in the kidney There is evidence in vasectomized rabbits that histological changes occur in the kidney that are consistent with early glomerulonephritis. It is speculated that these changes were precipitated by the autoimmune response that resulted in the deposition of immune complexes in the renal glomeruli (6). The fact that circulating immune complexes related to vasectomy have not been found in man, or have been found only transiently (10), argues against the possible sequence of events connecting vasectomy, immune complexes, kidney disease, and hypertension.

In summary, this study shows no association between atherosclerotic disease and vasectomy in men. It generally supports another study in humans which found no excess of myocardial infarctions in vasectomized men (16).

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